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NOTES ON GEOGRAPHIC DISTRIBUTION

First records of *Procellaria cinerea* Gmelin, 1789 and *Pachyptila vittata* (Forster, 1977) from the state of São Paulo, southeastern Brazil (Aves, Procellariiformes)

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Abstract. *Procellaria cinerea* Gmelin, 1789 and *Pachyptila vittata* (Forster, 1977) are considered vagrants in Brazil, with very few documented records in the country. Here, we present the first documented records of these species from the state of São Paulo, southeastern Brazil. Morphometrics, post-mortem examinations, and a genetic analysis allowed us to identify the species, reproductive status, cause of death, and sex of the specimens.

Key words. Atlantic Ocean, beach survey, migratory syndrome, plastic debris, PMP-BS, seabirds

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INTRODUCTION

The order Procellariiformes is one of the most adapted groups of seabirds to the marine environment, traveling long distances and spending most of their lives over vast open oceans (Schreiber and Burger 2001). *Procellaria cinerea* Gmelin, 1789 (Gray Petrel) has a circumpolar Southern Hemisphere distribution and breeds on the Gough Island and Tristan da Cunha Archipelago (United Kingdom), Prince Edward and Marion Islands (South Africa), Crozet, Kerguelen and Amsterdam Islands (French Southern Territories), Campbel and Antipodes Islands (New Zealand), and Macquarie Islands (Australia) (Harrison et al. 2021; Birdlife 2024a). This species is considered vagrant in Brazil, with apparently irregular occurrence (Pacheco et al. 2021). To date, only two published records exist: one from the state of Bahia (Lima et al. 2004) and another from Rio Grande do Sul (Vooren and Fernandes 1989; Bencke et al. 2010). Both specimens are housed in museum collections (Carlos 2009). *Pachyptila vittata* Forster, 1777 (Broad-billed Prion) has an extensive range across the Southern Hemisphere's oceans and coastal areas (Harrison et al. 2021). Breeding colonies are found on Gough Island and Tristan da Cunha Archipelago (United Kingdom), on the Chatham, Snares and South Islands (New Zealand) (Jones 2018; Harrison et al. 2021; Birdlife 2024b). In Brazil, *P. vittata* is also considered a vagrant (Pacheco et al. 2021), with a single documented record: a beached individual found in October 1979 on Cassino Beach, Rio Grande do Sul (Carlos 2005).

Most information about seabird occurrences in Brazil comes from surveys and stranding records along the coastline (Vooren and Fernandes 1989). Beach monitoring programs provide critical insights into spatial and temporal patterns of occurrence, age structure, sex ratios, mortality rates, and potential causes of death. They also track variations linked to climatic and anthropogenic factors, offering an overview of marine ecosystem health (Mäder et al. 2007; Chupil et al. 2024). The Beach Monitoring Project of the Santos Basin ("Projeto de Monitoramento de Praias da Bacia de Santos" – PMP-BS) is a pioneering monitoring program that daily covers an extensive coastal region (>1.500 km) in the South and Southeast regions of Brazil in search for stranded marine megafauna (Comunica Bacia de Santos 2024). Given the limited data on the occurrence and distribution of *P. cinerea* and *P. vittata* in Brazil, we provide the first documented records of these species from the state of São Paulo, southeastern Brazil.

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METHODS

Both birds had been rescued by staff from the Instituto de Pesquisas Cananéia (IPeC) as part of the Beach Monitoring Project of the Santos Basin. This program is one of several required by Brazil's Federal Environmental Agency ("Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis" – IBAMA) as part of the licensing process for oil production and transport by Petrobras in the pre-salt province (Comunica Bacia de Santos 2024). Post-mortem examinations were performed to determine the cause of death, reproductive status through micro and macroscopic characterization of the gonads, and sex. Identifications were based on morphological characters and due to the similarity between *Pachyptila* spp., genetic analyses were also conducted for this specimen.

Morphometric measurements were performed using manual calipers (precision of 0.1 mm) and a steel ruler (precision of 1 mm) according to Mallory and Forbes (2005) for the following body characters: head length (HL), bill width at the base of forehead feathers (BWF), maximum bill depth (MBD), bill depth at nostril (BDN), bill depth at gonys (BDG), culmen length (CL), bill length from nostril to the distant part of the curve of the hooked bill (NHB), tarsus length from wrist (TLW), foot length from III digit including claw (FL), middle toe length (MTL), middle toe length including claw (MTLC); wing length, from the largest remiges to the wing curvature (WL), tail length (TL), tarsus diameter (TD) and total body length from beak to tail (CT).

Total DNA was extracted from the skin sample of the *Pachyptila vittata* specimen (ID229101) using the Wizard Genomic DNA Purification Kit (Promega, Madison, WI, USA) according to the manufacturer's instructions. The primers used and the conditions for amplifying a region of approximately 900 bp of the mitochondrial gene cytochrome c oxidase subunit 1 (COI) were those recommended by Tavares and Baker (2008). The purified amplicons from COI were sequenced in both directions using the Applied-Biosystem Automated 3730XL DNA sequencer (Macrogen, Seoul, South Korea). Sanger sequencing chromatograms were visually inspected using CHROMAS PRO v. 1.5 software and forward and reverse reads were compared pairwise to exclude the possible sequencing errors. The 773 bp consensus sequence generated was used as a query for species identification in the Barcode of Life Data Systems (BoldSystems) database (https://www.boldsystems.org/) and in phylogenetic analysis. In addition, we used maximum likelihood (ML) to determine specimen-specific status, using a COI dataset with 36 specimens, 34 of which were from the genus *Pachyptila* Illiger, 1811 and two of the closely related *Halobaena caerulea* (Gmelin, 1789) (Blue Petrel) as an outgroup that were aligned using ClustalW in MEGA v. 7 (Kumar et al. 2016). JModelTest v. 2.1.1 (Darriba et al. 2012) was used for the statistical selection of the best nucleotide substitution model based on the alignment of the COI gene DNA sequences. JModelTest v. 2.1.1 (Darriba et al. 2012) was used for the statistical selection of the best nucleotide substitution model based on the alignment of the DNA sequences from the COI dataset. The model selected as the best fit was HKY+I (0.8427), which was used in the phylogenetic analysis. Phylogenetic analysis was performed with the maximum-likelihood method using the PHYML algorithm in SeaView v. 4 software (Guindon and Gascuel 2010). The confidence of the clades was statistically evaluated by non-parametric bootstrap support (Felsenstein 1985) with 1000 pseudo-replications. We considered bootstrap values ≥70% to be strongly supported (Hillis and Bull 1993).

RESULTS

Procellaria cinerea **Gmelin, 1789**
Figures 1, 2

New record. BRAZIL – SÃO PAULO • municipality of Iguape, Juréia Beach; 24°38′46.5″S 047°22′14.9″W; 0 m alt.; 10.XII.2023; Pedro Sardinha do Prado, Carolina de Castro Treza and Mariana Fischer Borges leg.; 1 ♀, adult, mature (presence of pre- and post-ovulatory follicles in ovary), taxidermy bird skin and skull: IPeC1286.

The individual was found alive on the beach by locals but died before the arrival of the rescue team (Figure 1).

Identification. A large ash-gray and white petrel with brownish gray mantle, back, uppertail-coverts and upperwings, and dark gray underwings, contrasting with white belly; pinkish feet and legs (Figure 2). Differs from other petrels and shearwaters in combination of white underparts and wholly dark underwing (Harrison et al. 2021; BirdLife 2024a), making the identification of this specimen straightforward as *P. cinerea*. Morphometric measurements: HL = 102 mm, BWF = 18.7 mm, MBD = 19 mm, BDN = 12 mm, BDG = 13 mm, CL = 47.7 mm, NHB = 31.1 mm, TLW = 45.6, FL = 74.1 mm, MTL = 57.1 mm, MTLC = 71 mm, WL = 324.9 mm, TL = 120 mm, TD = 65 mm, and CT = 530 mm.

Post-mortem examination reveals a moderate ectoparasite load (*Naubates fuliginosus* Taschenberg, 1882; *Halipeurus* sp. and *Austromenopon* sp.), and the presence of helminth endoparasites in the stomach (*Seuratia shipleyi* Stossich, 1900) and intestinal tract (*Tetrabothrius* sp.). Lower and upper beaks from squid (Mollusca, Cephalopoda) were retrieved from stomach contents (material preserved at IPeC's scientific collection). Macroscopic findings and histopathological analysis indicate cachexia and metabolic syndrome

as causes of death, mainly due to skeletal muscle and myocytes atrophies, lack of adipose tissue, adrenal congestion, and hepatocyte atrophy (Wüst and Lierz 2018).

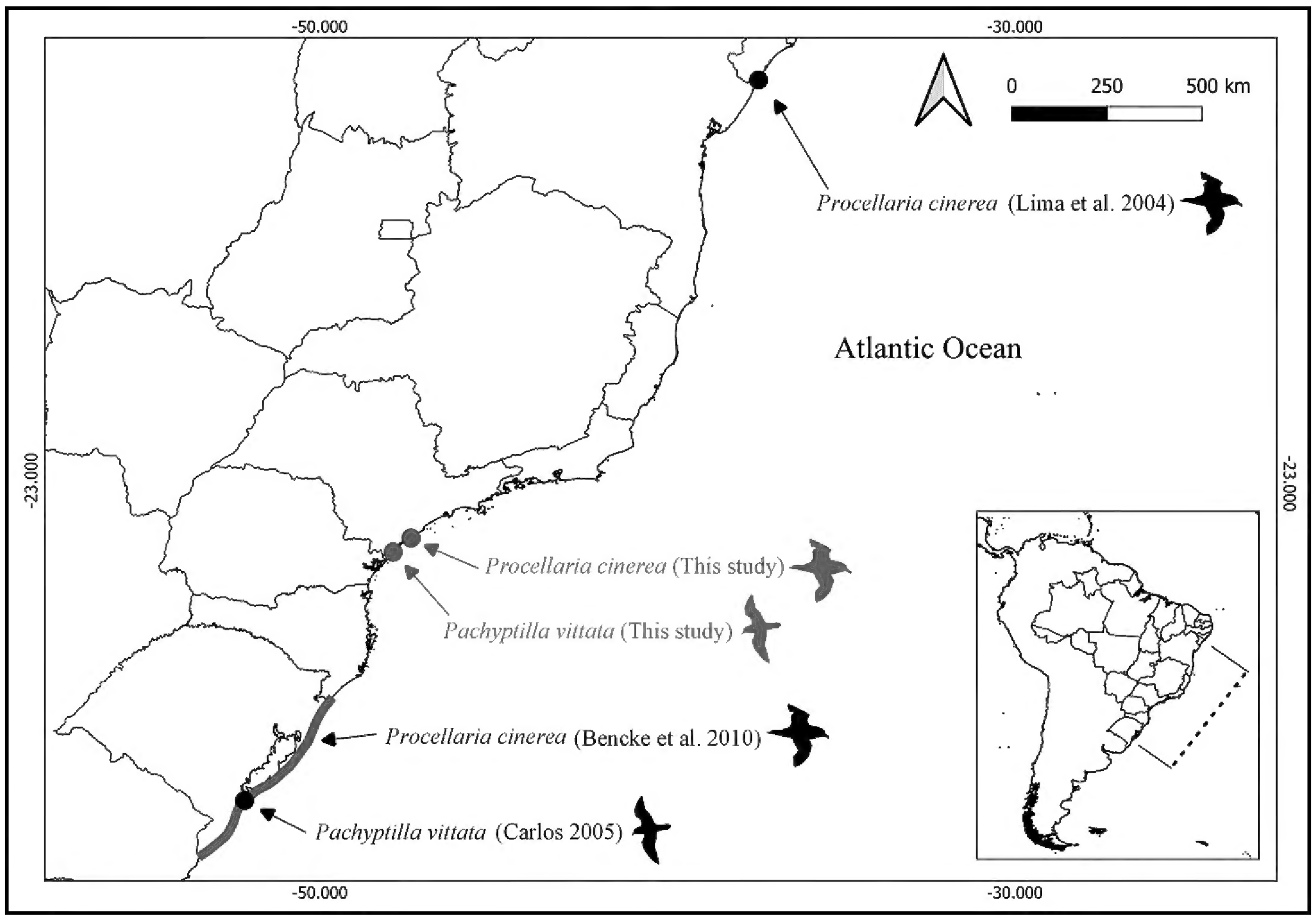

Figure 1. *Procellaria cinerea* and *Pachyptila vittata* along the Brazilian coast. Black dots: previous records (Lima et al. 2004; Carlos 2005). Gray line: previous record on the coast of Rio Grande do Sul, location not provided (Bencke et al. 2010). Blue dots: new records.

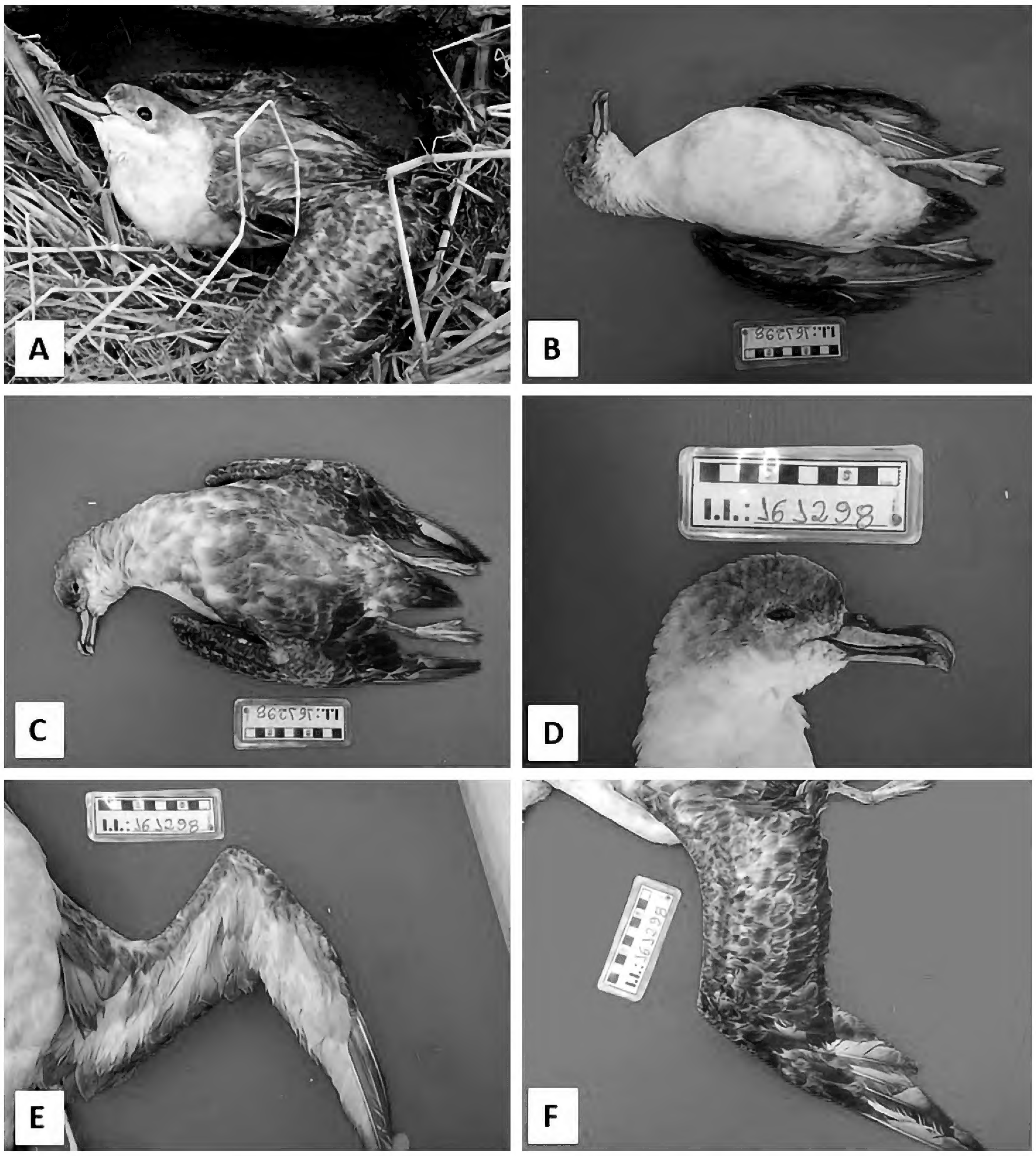

Figure 2. *Procellaria cinerea*. **A.** Live petrel found by the IPeC beach monitoring team. **B.** Ventral view. **C.** Dorsal view. **D.** Lateral view of the head, emphasizing bill morphology and color consistent with specimens of the *Procellaria* genus. **E.** Ventral side of wing. **F.** Dorsal side of wing.

Pachyptila vittata **(Forster, 1777)**

Figures 1, 3, 4

New record. BRAZIL – São Paulo • municipality of Ilha Comprida, Boqueirão Sul, Trincheira Beach; 25°03′01.0″S 047°53′12.0″W; 0 m alt.; 10.XII.2022; Thais Marcondes Schreiner, João Victor da Silveira Bertão and Flavio Pascoal de Souza leg.; barcodes/identifiers GenBank: PP980447; 1 ♂, adult, immature (presence of immature testicular tissue) taxidermy bird skin, IPeC929.

The individual was found stranded alive on the beach and rescued by the IPeC team (Figure 1). The bird presented fatigue, apathy, hypothermia, and emaciation. Despite of receiving specialized treatment, it died within 24 hours.

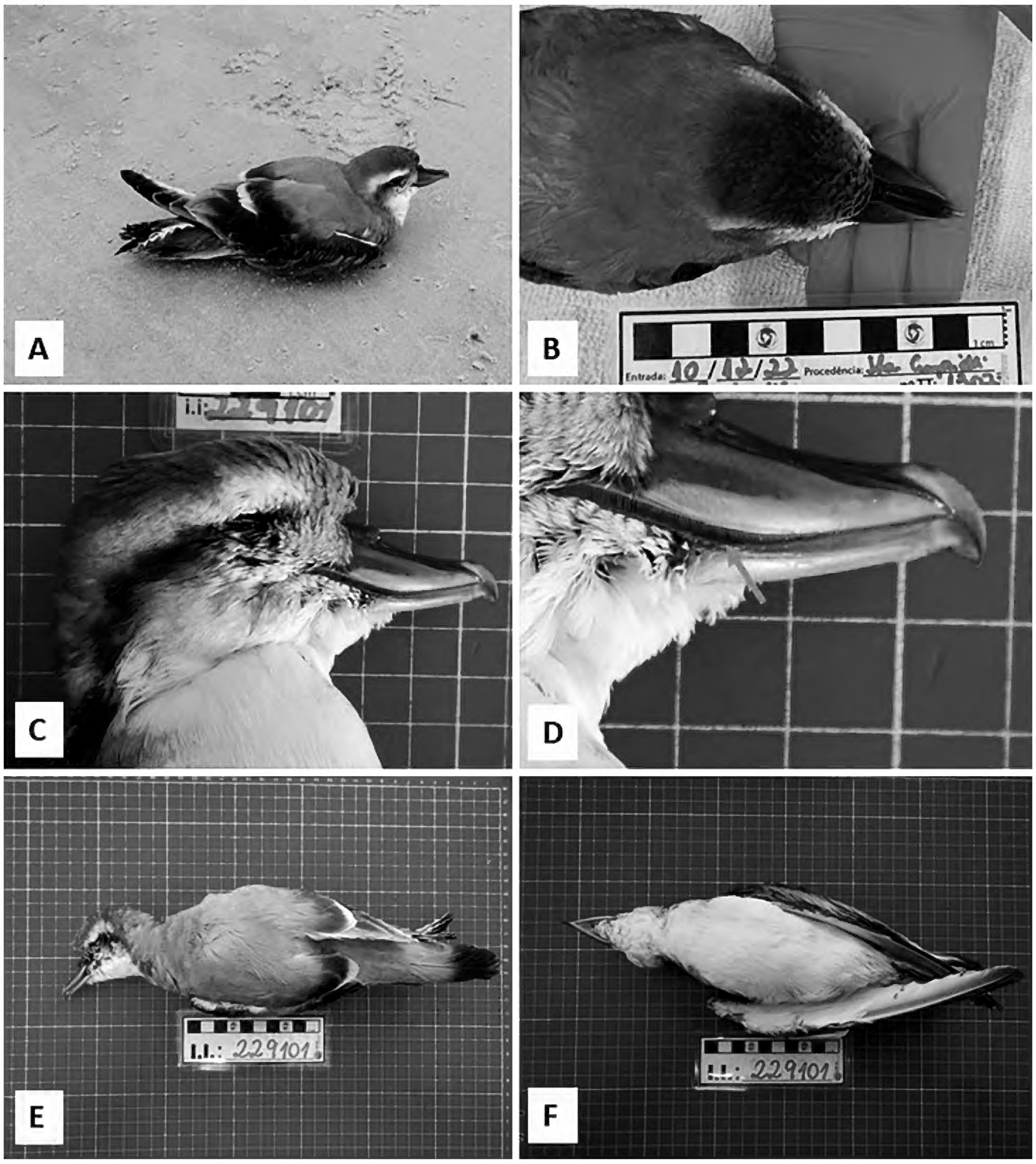

Figure 3. *Pachyptila vittata*. **A.** Live prion found by the IPeC rescue team. **B.** Top of the head, showing a bluish-gray crown and a wide dark bill consistent with specimens of *P. vittata*. **C.** Lateral view of the head. **D.** Bill with a pronounced palatal lamellae typical of the genus *Pachyptila* (orange arrow). **E.** Dorsal view. **F.** Ventral view.

Table 1. Differences in bill and body dimensions (mm) between *Pachyptila* species (mean, minimum, and maximum measurements reported for each species).

	Culmen length	**Bill width**	**Wing length**	**Tail Length**
P. vittata	34.75 (31.5–38)*	21.7 (19.1–24.4)‡	210 (191–229)*	105 (90–120)*
P. macgillivrayi	31 (29.5–32.5)†	17.3 (15.6–18.9)‡	200 (190–210)†	95.5 (91–100)*
P. salvini	31.4 (27.5–35.3)†	16.8 (15.2–18.6)†	195.5 (184–207)†	92 (80–104)*
P. desolata	27.1 (24.7–29.5)†	14.3 (12.2–16.5)‡	185.5 (176–195)†	89.5 (79–100)*
P. belcheri	25.1 (23–27.3)†	11.2 (9.9–12.5)‡	178.5 (172–185)†	85 (74–96)*
P. turtur	22.5 (20–25)†	11.4 (10–12.8)‡	178.5 (168–189)†	88.5 (78–99)*
P. crassirostris	21.8 (19–24.7)*	12.3 (9.9–14.7)*	181 (175–187)*	94 (81–107)*
This study	32.1	19.1	206	122

*Harper (1980), †Bretagnolle et al. (1990), and ‡Masello et al. (2019)

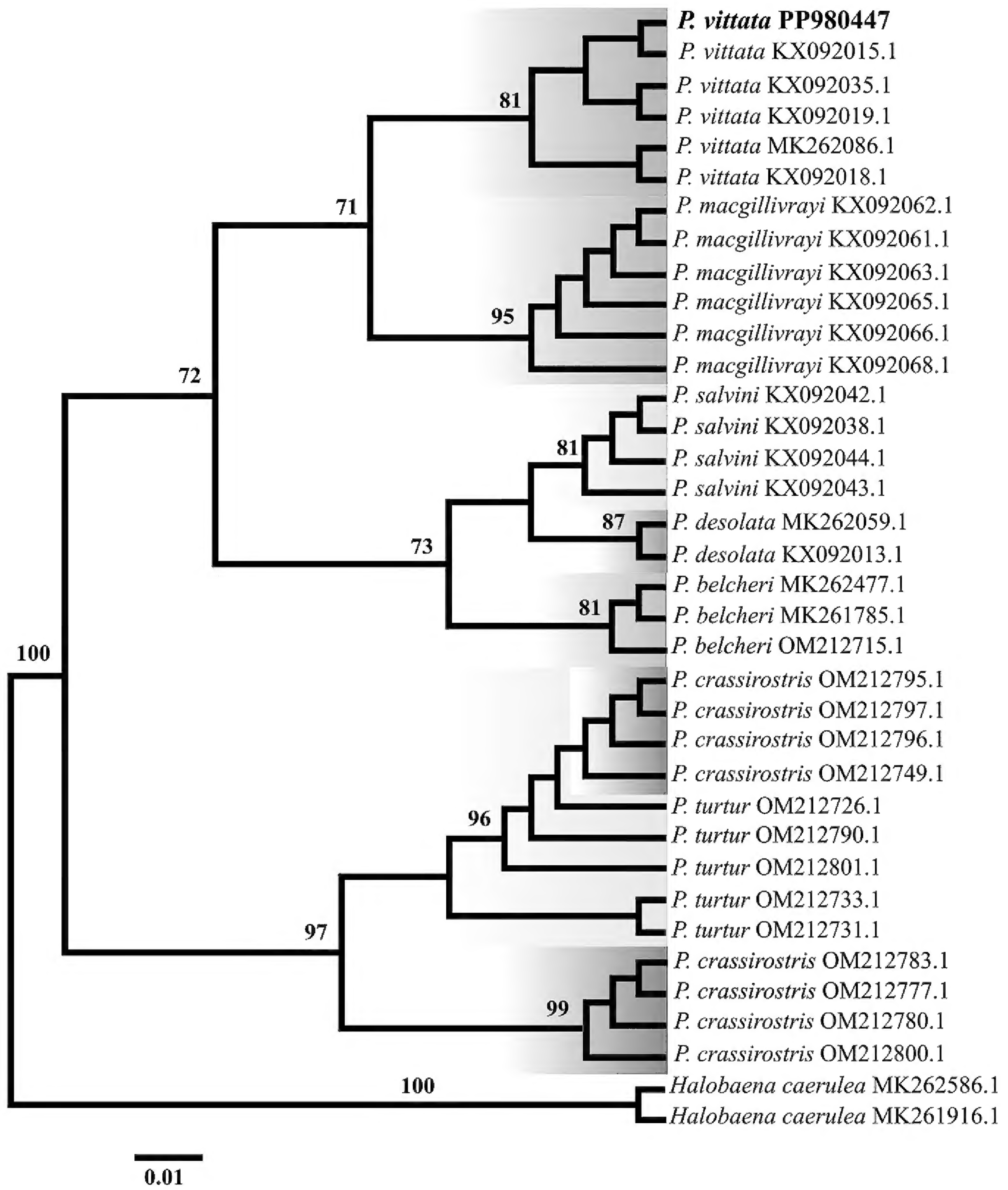

Figure 4. Phylogenetic relationships of cytochrome c oxidase subunit I gene inferred from maximum likelihood. Values of weakly supported nodes (bootstrap support <70%) are not reported in the tree. Scale bar represents the number of nucleotide substitutions per site. Along with species' names are GenBank accession numbers. Bold letters indicate the specimen recorded in this study and its identification as *Pachyptila vittata*.

Identification. *Pachyptila* prions are similar in appearance and behavior, differing mainly in bill shape. All species are small to medium-sized seabirds, have bluish-gray upperparts and white underparts, and blue legs and feet. *Pachyptila vittata* is the largest prion species and has a larger forehead and a bill that is larger, wider, and darker than all other species (Harrison et al. 2021). *Pacyptila vittata* has a black-tipped tail and a pronounced dark "M" from wingtip to wingtip across the lower back. The head has a bluish-gray crown with a dark eye stripe below a white supercilium (Figure 3). Morphometric measurements: HL = 70.7 mm, BWF = 19.1 mm, MBD = 15.1 mm, BDN = 12.2 mm, BDG = 7.5 mm, CL = 32.1 mm, NHB = 26.1 mm, TLW = 31.6, FL = 45 mm, MTL = 34.8 mm, MTLC = 39.7 mm, WL = 206 mm, TL = 122 mm, TD = 3.7 mm and CT = 307 mm.

Pachyptila prions pose one of the greatest identification challenges among seabirds due to their uniform appearance, differing mainly in bill size and structure (Table 1) (Shirihai 2007). Although *P. vittata* is considered the largest prion species with an exceptionally wide bill, significant variations in bill width have been previously reported on Gough Island; the occurrence of narrower-billed *P. vittata* could overlap with bill sizes of *Pachyptila macgillivrayi* (Mathews, 1912) (MacGillivray's Prion) and *Pachyptila salvini* (Mathews, 1912) (Salvin's Prion) (Ryan et al. 2014; Masello et al. 2022). However, the bill color of *P. vittata* is usually darker than all other prion species, ranging from all-black or black culmen and paler sides. The bill unguis is small and often ridged, and the culminicorn is broad and black. The large latericorns are glossy iron-gray and the mandibular rami are violet blue. The pale lemon-yellow palatal lamellae are well developed, and clearly visible when the bill is closed. *Pachyptila macgillivrayi* and *P. salvini* have black nasal tube and blackish culmen, with bluish latericorn, naricorn and mandible (Harper 1980; Harrison et al. 2021). One of the most fundamental aspects of ecological research and monitoring is accurate species identification (Baerwald 2020). Despite morphological characteristics and morphometrics that support individual identification as *P. vittata*, we performed genetic analyses for more reliable taxonomic identification.

Post-mortem examination reveals the presence of different shape and size plastic debris in the stomach, composed mainly of hard plastic fragments (0.5–1 cm in size), plastic films (0.5–1.5 cm in size), and a piece of nylon thread (2.5 cm in size). Macroscopic findings and histopathological analysis indicate both

cachexia and drowning as primary and secondary causes of death (respectively), due to the presence of skeletal muscle atrophy, lack of adipose tissue, pulmonary congestion and edema, metabolic myopathy, and lymphoid depletion (Vanstreels et al. 2016; Simpson and Fisher 2017; Wüst and Lierz 2018).

Genetic approach. The result showed that the sequence belonged to the genus *Pachyptila* (100%). However, DNA barcode-based discrimination at the species-level was not possible. According to the BoldSystems Identification System (IDS) the sample could be one of the five species in the genus: *P. vittata*; *P. belcheri* (Mathews, 1912) (Slender-billed prion); *P. desolata* (Gmelin, 1789) (Antarctic Prion); *P. turtur* (Kuhl, 1820) (Fairy Prion) and *P. salvini*. The maximum likelihood phylogenetic tree found by PHYML recovered *Pachyptila* as a monophyletic group with strong support (100% bootstrap), while the specific status of the other species in the genus exhibited good support (> 80%), *P. crassirostris* (Mathews, 1912) (Fulmar Prion) showed itself to be paraphyletic. The result of the phylogenetic analysis showed that *P. vittata* is closer to *P. macgillivrayi*, the species with the greatest morphological similarities (Ryan et al. 2014), but that the specimen in this study was recovered as *P. vittata* with bootstrap support of 81% (Figure 4).

DISCUSSION

The morphological characters of *P. cinerea* allowed for precise species identification (Harrison et al. 2021). This species has a circumpolar distribution in the Southern Ocean and disperses widely during the non-breeding season. It returns to breeding colonies in the austral autumn, with first appearances typically in February and March. Eggs are laid from late March to early April, and chicks fledge between late September and early December (Zotier 1990; Agreement on the Conservation of Albatrosses and Petrels 2009; Birdlife 2024a).

Here, we report a sexually mature female *Procellaria cinerea*, evidenced by the presence of pre- and post-ovulatory follicles in the ovary, stranded in December 2023. This suggests that the bird could have been a recent breeder. Vooren and Fernandes (1989) similarly reported a stranding of *P. cinerea* in November in the state of Rio Grande do Sul. The close timing of these two records suggests that *P. cinerea* may regularly occur in Brazilian waters during November and December, coinciding with the end of their breeding season and the subsequent wider dispersion from colonies. No information on sex or sexual maturity was provided for the *P. cinerea* specimen previously recorded in the state of Bahia. (Lima et al. 2004).

Despite being among the most abundant seabirds in the Southern Ocean, *Pachyptila* prions remain poorly understood in terms of their taxonomy, distribution, and foraging ecology (Cherel et al. 2002; Onley and Scofield 2007; Masello et al. 2019). Their morphological similarities further complicate species identification, making the recording and accurate identification of specimens particularly significant. Initially, the inclusion of *Pachyptila vittata* on the Brazilian bird list was based on a single specimen collected in October 1979 at Cassino Beach (Carlos 2005). In South America, reports of *P. vittata* are scarce. Hidalgo-Aranzamendi et al. (2010) documented five carcasses of the species stranded along the Peruvian coast between July and September 2009, nearly 30 years after the first South American record (Hughes 1982). Similarly, Portflitt-Toro et al. (2018) reported a stranding in February 2014 on the Chilean coast. Given the limited number of records across the continent and their occurrence in different months, it remains difficult to establish a clear pattern for when *P. vittata* strandings might be more frequent along the South American coast. The species' breeding season spans from August to November, after which they disperse widely across the South Atlantic Ocean (Jones et al. 2020). The post-mortem findings of *P. cinerea* and *P. vittata* were consistent with migratory syndrome, a metabolic disorder common to migrating species (Piersma 2005; Klassen et al. 2012). Given the high physiological demands of long-distance movements and the challenge they must endure during migration (such as contaminants, diseases, weather conditions, and reductions in food availability), migratory species may start catabolizing their energy storages, leading to a generalized weakness and fatigue (Klassen et al. 2012). Nonspecific pulmonary lesions, such as hemorrhagic pneumonia, pulmonary congestion, and edema, were also found in *P. vittata* and have been described in dry-drowned animals (Simpson and Fisher 2017). Another important finding in this specimen was the presence of solid waste fragments in the stomach, which could have hindered or reduced the digestion and absorption of food/nutrients, contributing directly to the development of cachexia (Padilla 2015).

In conclusion, species lists play a crucial role in understanding both the temporal and spatial patterns of species distributions (Silveira and Uezu 2011). Systematic beach monitoring programs that cover extensive coastal areas significantly enhance the likelihood of recording seabird species that are rare or previously unrecorded in Brazil or specific regions of the country (Chupil et al. 2018, 2019; Cabral et al. 2023). As such, these monitoring efforts serve as an indispensable tool for expanding knowledge on seabird occurrences in Brazil. In addition, they offer valuable opportunities for the collection of biological samples and the deposition of specimens in scientific collections and museums, further contributing to research and conservation efforts.

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ADDITIONAL INFORMATION

Conflict of interest

The authors declare that they have no competing interests.

Ethical statement

No ethical statement is reported.

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Author contributions

Conceptualization: HC. Data curation: HC. Formal analysis: HC, RH, TMS, VHV. Investigation: HC, RH, TMS, VHV. Methodology: HC, VHV. Supervision: HC. Visualization: HC, RH, TMS, VHV. Project administration: HC, RH, TMS, VHV. Software: VHV. Validation: HC, RH, TMS, VHV. Writing – original draft: HC, RH, TMS, VHV. Writing – review and editing: HC, RH, TMS, VHV.

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Data availability

All data supporting the findings of this study are available in the main text.

REFERENCES

Agreement on the Conservation of Albatrosses and Petrels (2009) ACAP Species assessments: Grey Petrel *Procellaria cinerea*. http://www.acap.aq. Accessed on 2010-09-28.

Baerwald MR, Goodbla AM, Nagarajan RP, Gootenberg JS, Abudayyeh OO, Zhang F, Schreier AD (2020) Rapid and accurate species identification for ecological studies and monitoring using CRISPR-based SHERLOCK. Molecular Ecology Resources 20 (4): 961–970.

Belton W (1984) Birds of Rio Grande do Sul, Brazil. Part 1, Rheidae through Furnariidae. Bulletin of the American Museum of Natural History 178 (4): 371–631.

Bencke GA, Dias RA, Bugoni L, Agne CE, Fontana CS, Maurício GN, Machado DB (2010) Revisão e atualização da lista das aves do Rio Grande do Sul, Brasil. Iheringia Série Zoologia 100 (4): 519–556. https://doi.org/10.1590/S0073-47212010000400022

BirdLife International (2024a) Species factsheet: *Procellaria cinerea*. https://datazone.birdlife.org/species/factsheet/grey-petrel-procellaria-cinerea. Accessed on: 2024-06-13.

BirdLife International (2024b) Species factsheet: *Pachyptila vittata*. https://datazone.birdlife.org/species/factsheet/broad-billed-prion-pachyptila-vittata. Accessed on: 2024-06-13.

Cabral JC, Ribeiro VL, Da Silva GC, Boaventura ICR, Laurindo LC, Do Valle CMDR, Do Valle RDR, Nascimento CC, Guimarães JP, Bertozzi CP (2023) First record of Sooty Tern, *Onychoprion fuscatus* (Linnaeus, 1766) (Laridae, Charadriiformes), from São Paulo state, Brazil. Check List 19 (6): 855–861. https://doi.org/10.15560/19.6.855

Carlos CJ (2005) Notes on the specimen record of the Broad-billed Prion *Pachyptila vittata* from Rio Grande do Sul, south Brazil. Ararajuba 13: 124–125.

Carlos CJ (2009) Seabird diversity in Brazil: a review. Sea Swallow 58: 17–46.

Cherel Y, Bocher P, De Broyer C, Hobson KA (2002) Food and feeding ecology of the sympatric thin-billed *Pachyptila belcheri* and Antarctic *P. desolata* prions at Iles Kerguelen, Southern Indian Ocean. Marine Ecology Progress Series 228: 263–281.

Chupil H, Maldaner B, Marques V (2018) First documented records of *Lugensa brevirostris* (Lesson, 1831) and *Phoebetria palpebrata* (Forster, 1785) for the state of São Paulo, southeastern Brazil (Aves, Procellariiformes). Check List 14 (2): 471–474. https://doi.org/10.15560/14.2.471

Chupil H, Marques V, Nagaoka S, Sardinha RS (2019) First record of Grey Gull *Leucophaeus modestus* in Brazil. Revista Brasileira de Ornitologia 27 (2): 140–142.

Chupil H, Farah RF, Maranho A, Barbosa CB, Leonardi S, Cabral J, Vieira JV, Rosa L, Do Valle RDR (2024) Insights into the ecology and conservation of coastal Brazil seabirds based on band returns. Marine Ornithology 52 (1): 37–44. http://doi.org/10.5038/2074-1235.52.1.1557

Comunica Bacia de Santos (2024) Projeto de Monitoramento de Praias da Bacia de Santos. https://comunicabaciadesantos.petrobras.com.br. Accessed on: 2024-06-20.

Darriba D, Taboada GL, Doallo R, Posada D (2012) jModelTest 2: more models, new heuristics and parallel computing. Nature Methods 9 (8): 772.

Felsenstein J (1985) Confidence limits on phylogenies: an approach using the bootstrap. Evolution 39 (4): 791–793. https://doi.org/10.1111/j.1558-5646.1985.tb00420.x

Guindon M, Gascuel O (2010) SeaView version 4: a multiplatform graphical user interface for sequence alignment and phylogenetic tree building. Molecular Biology and Evolution 27(2): 221–224. https://doi.org/10.1093/molbev/msp259

Harper PC (1980) The field identification and distribution of the prions (genus *Pachyptila*), with particular reference to the identification of storm-cast material. Journal of the Ornithological Society of New Zealand 27(3): 235–286.

Harrison P, Perrow M, Larsson H (2021) Seabirds: the new identification guide. Lynx Editions, Barcelona, Spain, 600 pp.

Hidalgo-Aranzamendi N, Alfaro-Shigueto, J, Zavalaga CB (2010) New records of Broad-billed Prions (*Pachyptila vittata*) in southern Peru. Notornis 57: 39–42.

Hillis DM, Bull JJ (1993). An empirical test of bootstrapping as a method for assessing confidence in phylogenetic analysis. Systematic Biology 42(2): 182–192. https://doi.org/10.1093/sysbio/42.2.182

Hughes RA (1982) Broad-billed prion at Mollendo, Peru: first record for the Pacific coast of South American. Condor 84: 130. https://doi.org/10.2307/1367840

Jones CWP (2018) Comparative ecology of *Pachyptila* species breeding sympatrically at Gough Island. Master thesis, University of Cape Town, Cape Town, South Africa, 86 pp.

Jones CW, Phillip RA, Grecian WJ, Ryan PG (2020) Ecological segregation of two superabundant, morphologically similar, sister seabird taxa breeding in sympatry. Marine Biology 167: 1–16. https://doi.org/10.1007/s00227-020-3645-7

Klaassen M, Hoye BJ, Nolet BA, Buttemer WA (2012) Ecophysiology of avian migration in the face of current global hazards. Philosophical Transactions of the Royal Society B, Biological Sciences 367 (1596): 1719–1732. https://doi.org/10.1098/rstb.2012.0008

Kumar S, Stecher G, Tamura K (2016) MEGA7: molecular evolutionary genetics analysis version 7.0 for bigger datasets. Molecular Biology and Evolution 33 (7): 1870–1874. https://doi.org/10.1093/molbev/msw054

Lima PC, Grantsau R, Lima RCFR, Santos SS (2004) Occurrence and mortality of seabirds along the northern coast of Bahia, and the identification key of the Procellariiformes order and the Stercorariidae family. Cetrel S.A, Salvador, Bahia, Brazil, 63 pp.

Mäder A, Sander M, Casa Jr G (2010). Ciclo sazonal de mortalidade do pinguim-de-magalhães, *Spheniscus magellanicus* influenciado por fatores antrópicos e climáticos na costa do Rio Grande do Sul, Brasil. Revista Brasileira de Ornitologia 18 (3): 228–233.

Mallory ML, Forbes MR (2005) Sex discrimination and measurement bias in Northern Fulmars *Fulmarus glacialis* from the Canadian Arctic. Ardea 93 (1): 25–36.

Masello JF, Quillfeldt P, Sandoval-Castellanos E, Alderman R, Calderón L, Cherel Y, Cole LT, Cuthbert RJ, Marin M, Massaro M, Navarro J, Phillips RA, Ryan PG, Shepherd JD, Suazo CG, Weimerskirch H, Moodley Y (2019) Additive traits lead to feeding advantage and reproductive isolation, promoting homoploid hybrid speciation. Molecular Biology Evolution 36: 1671–1685. https://doi.org/10.1093/molbev/msz090

Onley D, Scofield P (2007) Albatrosses, petrels and shearwaters of the world. Princeton University Press, London, United Kingdom, 256 pp.

Pacheco JF, Silveira LF, Aleixo A, Agne CE, Bencke GA, Bravo GA, Brito GRR, Cohn-haft M, Maurício GN, Naka LN, Olmos F, Posso S, Lees AC, Figueiredo LFA, Carrano E, Guedes RC, Cesari E, Franz I, Schunck F, Piacentini VQ (2021) Annotated checklist of the birds of Brazil by the Brazilian Ornithological Records Committee – Second Edition. Ornithology Research 29 (2): 94–105.

Padilla LR (2015) Gaviiformes, Podicipediformes, and Procellariiformes (Loons, Grebes, Petrels, and Albatrosses). In: Miller RE, Fowler ME (Eds) Fowler'S Zoo and Wild Animal Medicine. Elsevier, Amsterdam, The Netherlands, 89–95. https://doi.org/10.1016/B978-1-4557-7397-8.00011-6

Phillips JD, Gillis DJ, Hanner, RH (2019) Incomplete estimates of genetic diversity within species: implications for DNA barcoding. Frontiers in Ecology and Evolution 9: 2996–3010. https://doi.org/10.1002/ece3.4757

Phillips JD, Gillis DJ, Hanner RH (2022) Lack of statistical rigor in DNA barcoding likely invalidates the presence of a true species' barcode gap. Frontiers in Ecology and Evolution 10: 859099. https://doi.org/10.3389/fevo.2022.859099

Piersma T, Pérez-Tris J, Mouritsen H, Bauchinger U, Bairlein F (2005) Is there a "migratory syndrome" common to all migrant birds? Annals of the New York Academy of Sciences 1046: 282-93. https://doi.org/10.1196/annals.1343.026

Portflitt-Toro M, Miranda-Urbina D, Luna-Jorquera G (2018) Specimen record confirms Broad-billed Prion *Pachyptila vittata* presence in Chilean waters. Marine Ornithology 46: 69–70. http://doi.org/10.5038/2074-1235.46.1.1251

Puillandre N, Lambert A, Brouillet S, Achaz, G (2012) ABGD, Automatic Barcode Gap Discovery for primary species delimitation. Molecular Ecology 21: 1864–1877. https://doi.org/10.1111/j.1365-294X.2011.05239.x

Ryan PG, Bourgeois K, Dromzée S, Dilley BJ (2014) The occurrence of two bill morphs of prions *Pachyptila vittata* on Gough Island. Polar Biology 37: 727–735. https://doi.org/10.1007/s00300-014-1473-2

Schreiber EA, Burger J (2001) Biology of marine birds. CRC Press, Hoboken, USA, 740 pp.

Shirihai H (2007) A complete guide to Antarctic wildlife. Princeton University Press, London, United Kingdom, 510 pp.

Silveira LF, Uezu A (2011) Checklist das aves do estado de São Paulo, Brasil. Biota Neotropical 11(1): 83–110. https://doi.org/10.1590/S1676-06032011000500006

Simpson VR, Fisher DN (2017) A description of the gross pathology of drowning and other causes of mortality in seabirds. BMC Veterinary Research 13: 1–14.

Tavares ES, Baker AJ (2008) Single mitochondrial gene barcodes reliably identify sister-species in diverse clades of birds. BMC Evolutionary Biology 8 (81): 1–14. https://doi.org/10.1186/1471-2148-8-81

Vanstreels RET, Hurtado R, Ewbank AC, Bertozzi CP, Catão-Dias JL (2016) Lesions associated with drowning in bycaught penguins. Diseases of Aquatic Organisms 121: 241–248.

Vooren CM, Fernandes AC (1989) Guia de Albatrozes e Petréis do Sul do Brasil. Sagra Editions, Porto Alegre, Rio Grande do Sul, Brazil, 99 pp.

Wüst E, Lierz M (2018) The Thin Bird. In: Chitty J, Monks D (Eds) BSAVA manual of avian practice. BSAVA Library, Quedgeley, United Kingdom, 377–388.

Zotier R (1990) Breeding ecology of a subantarctic winter breeder: the Grey Petrel *Procellaria cinerea* on Kerguelen Island. Emu Austral Ornithology 90 (3) 180–184.